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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/825,910

04/16/2004

Byung Tai Do

27-017

8877

22898

7590

08/21/2006

EXAMINER

HO, TU TU V

THE LAW OFFICES OF MIKIO ISHIMARU

333 W. EL CAMINO REAL

SUITE 330

SUNNYVALE, CA 94087

ART UNIT

PAPER NUMBER

2818

DATE MAILED: 08/21/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/825,910	DO ET AL.	
	Examiner	Art Unit	
	Tu-Tu Ho	2818	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on 25 May 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 17 August 2005 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date: _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date: _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Applicant's Amendment filed 05/25/2006 has been reviewed and placed of record in the file.
2. Applicant's arguments with respect to amended claims 1-20, filed 05/25/2006, have been considered but they are moot in view of new ground(s) of objection and rejection.

Drawings

3. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "electrically connecting the heat sink to the substrate using a number of bonding wires" and the "attaching the plurality of legs to the substrate" of **claims 1 and 11** must be shown or the feature(s) canceled from the claim(s). Specifically, as detailed below in the 112-section rejection, although Applicant discloses, in the passing, "The heat sink 900 is representative of the heat sink 200 shown in FIGS. 2-4, and the heat sink 600 shown in FIGS. 6-8" and "the heat sink 900 may be plated as described in connection with the embodiment shown in FIGS. 5-8 above" (Specification, page 9), the passing disclosure is not the same as claimed, wherein the heat sink is attached to the substrate using a number of bonding wires and the plurality of legs. No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet,

Art Unit: 2818

even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The replacement sheet(s) should be labeled “Replacement Sheet” in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 1-5 and 11-15 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Specifically, **claim 1** recites:

A method of assembling a semiconductor package with stacked dies comprising:
providing a substrate;

attaching a first die to the substrate;
electrically connecting the first die to the substrate;
attaching a heat sink to the first die;
electrically connecting the heat sink to the substrate using a number of bonding wires;
the heat sink comprising a body portion, an undercut portion around a periphery thereof,
and a plurality of legs integrally formed with the undercut portion;
attaching the plurality of legs to the substrate (italics added);
attaching a second die to the heat sink;
electrically connecting the second die to the substrate; and
encapsulating the first die, the heat sink, and the second die.

Applicant cited, as support for the amendment, Specification page 6, lines 10-11:

“Additionally, a third number of bonding wires 306 can be used between the heat sink 200 and the substrate 102 to conduct heat away from the heat sink 200 to the substrate 102.”

However, the cited section is directed to the embodiment of Figs. 1-4, wherein the heat sink 200 as shown does not have a plurality of legs integrally formed with the undercut portion 204 as claimed. Specifically, in the embodiment of Figs. 1-4, it is reasonable for electrically connecting the heat sink to the substrate using a number of bonding wires as amended so as to “conduct heat away from the heat sink 200 to the substrate 102”, because the heat sink 200 as shown does not have a plurality of legs integrally formed with the undercut portion.

Nevertheless, because the claim also requires that the heat sink comprise “a plurality of legs integrally formed with the undercut portion”, which is clearly shown in Figs. 9-10, wherein, clearly via integrally formed legs 904, “If the heat sink 900 is to be used as an electrical ground

Art Unit: 2818

connection, the heat sink 900 can be attached to a substrate using an electrically conductive adhesive, such as silver epoxy” (Specification, page 9, lines 11-14). In other words, the heat sink 900, being electrically conductive, should also be, as is known in the heat sink art and because it is a heat sink, thermally conductive. Since heat sink 900 is thermally conductive, the integrally formed legs 904 - being substantially larger in cross section than a bonding wire, as is known in the pertinent art and as is shown, for example bonding wire 306 - are thermally conductive, and consequently should be substantially more thermally conductive than a bonding wire, which raise a question as to the real existence of a bonding wire in this embodiment.

It is acknowledged that Applicant discloses, in the passing, “The heat sink 900 is representative of the heat sink 200 shown in FIGS. 2-4, and the heat sink 600 shown in FIGS. 6-8” and “the heat sink 900 may be plated as described in connection with the embodiment shown in FIGS. 5-8 above” (Specification, page 9); however, the passing disclosure is not the same as claiming:

“electrically connecting the heat sink to the substrate using a number of bonding wires;
the heat sink comprising a body portion, an undercut portion around a periphery thereof,
and a plurality of legs integrally formed with the undercut portion;

attaching the plurality of legs to the substrate (italics added);”

Claims 2-5 depend from rejected claim 1 and include all limitations of claim 1 and are rejected for the same reason.

Claim 11 is similar in scope as far as the amendment is concerned, and is rejected for the same reason.

Claims 12-15 depend from rejected claim 11 and include all limitations of claim 11 and are rejected for the same reason.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

5. Claims 16-18, 20, 6-8, and 10 are rejected under 35 U.S.C. §103(a) as being unpatentable over Chung et al. U.S. Patent Application Publication 20040183180 (the ‘180 reference, cited in a previous office action) in view of Hoffman et al. U.S. Patent 6,737,750.

The ‘180 reference discloses in the figures, particularly Figs. 3 and 5, and respective portions of the specification a thermally enhanced semiconductor package with a stack of dies substantially as claimed including a heat sink but does not teach a number of bonding wires electrically connecting the heat sink to the dies in the stack. Specifically, in reference to **claim 16**, the reference discloses a thermally enhanced semiconductor package with a stack of dies comprising:

a heat sink (“supporter” 35, paragraph [0021], which can be a heat spreader, paragraph [0023], Fig. 5) between dies (“chips” 34 and 32) in the stack;

the heat sink having a body portion (352), an undercut portion (generally indicated at a portion of supporting portion, or leg 354) around a periphery thereof, and a plurality of legs (“slant columns”, paragraph [0021]: “the supporting portion 354 may be a ring or is composed of slant columns connecting to the carrying portion”) integrally formed with the undercut portion.

However, as noted above, the reference does not teach a number of bonding wires electrically connecting the heat sink to the dies in the stack.

Hoffman, in also disclosing a thermally enhanced semiconductor package with a stack of dies (12, 16, Fig. 2) comprising a heat sink (14) between dies in the stack, teaches a number of bonding wire(s) electrically connecting the heat sink 14 to the dies in the stack so as to provide a ground conductive path or other reference voltage to an upper surface 16a of the second die 16 (Fig. 2, col. 5, lines 45-64).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the reference's device such that a number of bonding wire(s) 22 electrically connect the heat sink 35 to the dies in the stack. One would have been motivated to make such a change so as to provide a ground conductive path or other reference voltage to an upper surface of the second die 32 as taught by Hoffman. Note also that although Hoffman shows only one bonding wire 22, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use more than one bonding wire for the purpose of providing a ground conductive path or other reference voltage.

Referring to **claim 17**, the reference further discloses that the undercut of the heat sink extends laterally over the die to which the heat sink is attached (as clearly depicted in Fig. 5).

Referring to **claim 18**, as noted above, the heat sink is electrically grounded.

Referring to **claim 20**, the reference further discloses that a heat sink is positioned between each adjoining pair of dies in the stack of dies ("each adjoining pair of dies in the stack of dies" is broadly interpreted as comprising two dies, and consequently "a heat sink is

positioned between each adjoining pair of dies in the stack of dies” is broadly interpreted as a heat sink is positioned between two dies).

Referring to **claim 6** and using the same reference characters, interpretations, and citations as detailed above for claim 16 where applicable, the reference in view of Hoffman discloses a thermally enhancing a semiconductor package with a stack of dies and an inherent method of thermally enhancing a semiconductor package with a stack of dies, the method comprising providing a heat sink between dies in the stack; the heat sink having a body portion, an undercut portion around a periphery thereof, a plurality of legs integrally formed with the undercut portion, and electrically connected using a number of bonding wires 22 to the stack of dies.

Referring to **claim 7**, the reference further discloses providing a heat sink attaches a heat sink that extends laterally over the lower die to which the heat sink is attached (as clearly depicted in Fig. 5).

Referring to **claim 8**, as noted above, providing a heat sink attaches a heat sink that is electrically grounded.

Referring to **claim 10**, the reference further discloses that providing a heat sink attaches a heat sink between each adjoining pair of dies in the stack of dies (“each adjoining pair of dies in the stack of dies” is broadly interpreted as comprising two dies, and consequently “a heat sink between each adjoining pair of dies in the stack of dies” is broadly interpreted as a heat sink between two dies).

6. **Claims 19 and 9** are rejected under 35 U.S.C. §103(a) as being unpatentable over Chung et al. U.S. Patent Application Publication 20040183180 (the '180 reference, cited in a previous office action) in view of Hoffman et al. U.S. Patent 6,737,750 as applied above and further in view of Figs.-12 embodiment of Hoffman.

The '180 reference in view of Hoffman discloses a semiconductor package with stacked dies and a method of assembling and using thereof as claimed and as detailed above for claims 16 and 6, including the stack of dies (34,32) comprising the heat sink (35) having said undercut around its periphery between said dies in said stack of dies, wherein the heat sink is electrically grounded to the substrate (36) and the second die (32). However, the '180 reference does not disclose that the heat sink has an electrically conductive coating connected to a ground plane on the substrate, for the purpose of said electrically grounding of said heat sink, and consequently also does not disclose that the second die 32 is connected to the claimed electrically conductive coating of the heat sink for the purpose of said attaching the second die to the heat sink.

Hoffman, in also disclosing a thermally enhanced semiconductor package with a stack of dies (12, 16, Fig. 12) comprising a heat sink (33) between dies in the stack, teaches an electrically conductive coating 30 on a surface of the heat sink 33 so as to provide a reference voltage to a surface 16b of the second die 16 through substrate 10 and heat sink 33 (col. 10, lines 40-48).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the heat sink of the '180 reference such that the heat sink has an electrically conductive coating. One would have been motivated to make such a modification in view of the Hoffman teachings in the embodiment of Figs. 12 that an electrically conductive

Art Unit: 2818

coating formed on a surface of the heat sink provides a reference voltage to a lower surface of the second die. Thus the final modified package would have a heat sink having an electrically conductive coating 30 connected to a ground plane on the substrate 36 and that the second die 32 would be connected to the electrically conductive coating 30 as the second die is connected to the heat sink which would have the electrically conductive coating 30, in order to provide a reference voltage to a lower surface of the second die 32.

7. **Claims 11-13, 15, 1-3, and 5** are rejected under 35 U.S.C. §103(a) as being unpatentable over Chung et al. U.S. Patent Application Publication 20040183180 (the '180 reference, cited in a previous office action).

The '180 reference discloses in the figures, particularly Figs. 3 and 5, and respective portions of the specification a semiconductor package with stacked dies substantially as claimed including a heat sink and a substrate but does not teach a number of bonding wires electrically connecting the heat sink to the substrate. Specifically, in reference to **claim 11**, the reference discloses a semiconductor package with stacked dies comprising:

- a substrate (36, Fig. 3, no number in Fig. 5); a
- first die attached to the substrate;
- the first die being electrically connected to the substrate;
- a heat sink attached to the first die (Fig. 5);
- the heat sink having a body portion, an undercut portion around a periphery thereof, and a plurality of legs integrally formed with the undercut portion;
- the plurality of legs attached to the substrate;

Art Unit: 2818

a second die attached to the heat sink and electrically connected to the substrate; and
an encapsulant (no number in Fig. 5, 39 in Fig. 3, paragraph [0021]) over the first die, the heat sink, and the second die.

However, as noted above, the reference does not disclose a number of bonding wires electrically connecting the heat sink to the substrate.

Nevertheless, as explained by Applicant in the specification and as cited by Applicant for supporting an amendment (*Applicant Arguments/Remarks Made in an Amendment*, filed 05/25/2006, page 7), the purpose of providing a number of bonding wires electrically connecting the heat sink to the substrate is to conduct heat away from the heat sink 200 to the substrate 102 (Specification, page 6, lines 10-11). Furthermore, as taught by Applicant on page 8, lines 16-23, of the Specification, the second ground wire 708 also provide a path for heat to be conducted away from the heat sink 600 to the substrate 502. As such, the heat sink/supporter 35 of the '180 reference, being made of copper metal and having a plurality of legs integrally formed with the undercut portion, also provides a path for heat to be conducted away from the chip 32 to the heat sink 35 to the substrate 36 (paragraph [0023]) in addition to providing a ground path (paragraph [0024]). The limitation, therefore, does not produce unexpected results and consequently would have been obvious to one of ordinary skill in the art at the time the invention was made.

Referring to **claim 12**, the reference further discloses a number of bonding wires (no number in Fig. 5, 37 in Fig. 3, paragraph [0021]) electrically connecting the first die to the substrate; and

wherein:

the undercut of the heat sink extends laterally over the number of bonding wires (as best seen in Fig. 5).

Referring to **claim 13**, as noted above, the reference further discloses that the heat sink is electrically grounded.

Referring to **claim 15**, the reference further discloses that the undercut of the heat sink extends laterally beyond the edges of the second die (32) (as best seen in Fig. 5).

Referring to **claim 1** and using the same reference characters, interpretations, and citations as detailed above for claim 11 where applicable, the reference discloses a semiconductor package with stacked dies and an inherent method of assembling a semiconductor package with stacked dies, the method comprising:

“providing a substrate;
attaching a first die to the substrate;
electrically connecting the first die to the substrate;
attaching a heat sink to the first die;
the heat sink comprising a body portion, an undercut portion around a periphery thereof,
and a plurality of legs integrally formed with the undercut portion;
attaching the plurality of legs to the substrate;
attaching a second die to the heat sink;
electrically connecting the second die to the substrate; and
encapsulating the first die, the heat sink, and the second die”

which method would make claim 1 unpatentable because the claimed limitation “electrically connecting the heat sink to the substrate using a number of bonding wires”, which is absent from the reference, does not produce unexpected results.

Referring to **claim 2**, the reference further discloses that electrically connecting the first die to the substrate uses a number of bonding wires (no number in Fig. 5, 37 in Fig. 3, paragraph [0021]); and

attaching a heat sink attaches a heat sink that extends laterally over the number of bonding wires.

Referring to **claim 3**, as noted above, the reference further discloses that attaching a heat sink attaches a heat sink that is electrically grounded.

Referring to **claim 5**, the reference further discloses that attaching a heat sink attaches a heat sink that extends laterally beyond the edges of the second die (32) (as best seen in Fig. 5).

8. Claims 14 and 4 are rejected under 35 U.S.C. §103(a) as being unpatentable over Chung et al. U.S. Patent Application Publication 20040183180 (the ‘180 reference, cited in a previous office action) in view of Hoffman et al. U.S. Patent 6,737,750

The ‘180 reference discloses a semiconductor package with stacked dies and a method of assembling and using thereof substantially as claimed and as detailed above for claims 11 and 1, including the stack of dies (34,32) comprising the heat sink (35) having said undercut around its periphery between said dies in said stack of dies, wherein the heat sink is electrically grounded to the substrate (36) and the second die (32). However, the ‘180 reference does not disclose that the heat sink has an electrically conductive coating connected to a ground plane on the substrate,

Art Unit: 2818

for the purpose of said electrically grounding of said heat sink, and consequently also does not disclose that the second die 32 is connected to the claimed electrically conductive coating of the heat sink for the purpose of said attaching the second die to the heat sink.

Hoffman, in also disclosing a thermally enhanced semiconductor package with a stack of dies (12, 16, Fig. 12) comprising a heat sink (33) between dies in the stack, teaches an electrically conductive coating 30 on a surface of the heat sink 33 so as to provide a reference voltage to a surface 16b of the second die 16 through substrate 10 and heat sink 33 (col. 10, lines 40-48).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the heat sink of the '180 reference such that the heat sink has an electrically conductive coating. One would have been motivated to make such a modification in view of the Hoffman teachings that an electrically conductive coating formed on a surface of the heat sink provides a reference voltage to a lower surface of the second die. Thus the final modified package would have a heat sink having an electrically conductive coating 30 connected to a ground plane on the substrate 36 and that the second die 32 would be connected to the electrically conductive coating 30 as the second die is connected to the heat sink which would have the electrically conductive coating 30, in order to provide a reference voltage to a lower surface of the second die 32.

Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office Action. See MPEP § 706.07(a).

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tu-Tu Ho whose telephone number is (571) 272-1778. The examiner can normally be reached on 7:30 am - 6:00 pm, Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Minsun Harvey can be reached on (571) 272-1835. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2818

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Tu-Tu Ho
July 27, 2006